Thermodynamics Features of Gd_{92.5}Y_{7.5} Alloy: The Thermal Expansion in Magnetic Fields*

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The large spin value of the heavy rare-earth element 4f-shells, as well as complex indirect exchange coupling between local spins via intermediate conduction electrons, lead to interesting features of the thermodynamics of the rare-earth based compounds and alloys. The phenomena associated with the spin-lattice interaction are of particular interest in solid state thermophysics. The interaction of magnetic systems of these objects with an external magnetic field leads to transformations in both magnetic and crystal structures and affects the thermal expansion parameter. A new first order phase transition at $T\sim248$ K was revealed in the Gd-Y substitution alloys by the ultrasonic technique [1]. The present paper is devoted to studying the linear thermal expansion in the range 80 < T < 370 K of one of the samples of paper [1] attempting to elucidate the character of the change of this transition under the influence of the magnetic field.

The polycrystalline sample $Gd_{92.5}Y_{7.5}$ was studied by the dilatometry technique in the transversal external magnetic fields 0.8, 2.6 and 9.0 kOe, which was reduced by the demagnetization factor to effective internal fields of approximately 0.1, 1.0 and 6.5 kOe, respectively. A "step" in the sample length temperature dependence of about 1.5 K width at $T\sim248$ K confirms the first-order character of the transition. External magnetic fields of 0.8 and 2.6 kOe have little affect on the step parameters (position and height), but a field of 9 kOe (6.5 kOe effective) completely suppresses it, so that no peculiarities are seen in the length-temperature curve in the vicinity of 248 K. The observed character of the field effects shows that the stability of the observed phase transformation in relation to the magnetic field is intermediate between the stability of the magnetic [2] and lattice [3] structures in pure gadolinium in the vicinity of the spin-reorientation phase transition.

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